

**RECOMMENDED PRACTICE
FOR
USE AND UPKEEP
OF
EQUIPMENT, TOOLS
AND APPLIANCES
FOR
BITUMINOUS PAVEMENT
CONSTRUCTION**



**THE INDIAN ROADS CONGRESS
2000**



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RECOMMENDED PRACTICE FOR USE AND UPKEEP OF EQUIPMENT, TOOLS AND APPLIANCES FOR BITUMINOUS PAVEMENT CONSTRUCTION

1. INTRODUCTION

1.1. A large variety of equipment, tools and appliances is needed for bituminous pavement construction. Modern construction techniques need sophisticated equipment and even the specifications which permit manual mixing and laying involve the use of smaller tools and appliances. As such some guidance is necessary for field engineers regarding the use and proper upkeep of different items of equipment, tools and appliances. This will help in systematic procurement, planning and execution of works and to exercise requisite quality control in the field.

1.2. It is with the above objective that this Recommended Practice has been prepared by the Bituminous Pavements Committee (personnel given below). It was then processed and approved by the Specifications and Standards Committee in their meeting held on 21st December, 1977. Later it was finally approved by the Executive Committee in their meeting held on the 22nd April, 1978 and by the Council in their 93rd meeting held on the 3rd June 1978.

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2. SCOPE

2.1. The Recommended Practice lists out the equipment, tools and appliances required for different types of bituminous pavement construction and gives some details about these for helping the field engineer in the planning and execution of works. For commercially fabricated equipment, reference has been drawn to the relative standard of ISI. For tools and appliances not covered by any standard, details along with dimensioned sketches have been included to facilitate their fabrication.

2.2. For convenience of reference, the items of equipment, tools and appliances are given under the following two categories:

- (i) Common tools and appliances which will generally be needed on all types of bituminous works; and
- (ii) Special equipment needed for individual Specifications.

3. COMMON TOOLS AND APPLIANCES

A list of tools and appliances commonly required for all types of bituminous works is given below:

- A. Tools and appliances for picking up or removing old pavement
 - (1) Pickaxes
 - (2) Crowbars
 - (3) Hammers
 - (4) Chisels
- B. Tools and appliances for laying out
 - (1) Pegs
 - (2) Nails
 - (3) Rope
 - (4) Measuring tape
 - (5) Chalk
 - (6) Angle iron or wooden strips of required dimension for edge support.
- C. Tools and appliances for cleaning the surface
 - (1) Wire brushes
 - (2) Coir brushes
 - (3) Broomis
 - (4) Old gunny bags
- D. Tools and appliances for handling materials
 - (1) Baskets (lined with gunny cloth)

- (2) Buckets (G.I.) 6-12 litres capacity
- (3) Empty drums or G.I. Sheet tanks for storage of water (200 litres capacity)
- (4) Wheel barrows
- (5) Hammer and cutter for opening bitumen drums
- (6) 30 and 15 litre capacity containers for measuring the aggregates
- (7) Shovels
- (8) Spades
- (9) Rakes (small) with short handles
- (10) Rakes (big) with long handles for levelling of mix
- (11) Spring balances (10 kg and 25 kg)
- (12) Bitumen boiler (preferably oil fired with pressure burner)
- (13) Chain pulley arrangement for lifting of drums
- (14) Tractor or other arrangement to pull the bitumen boiler.

E. Tools and appliances for checking the accuracy of the work

- (1) Thermometres, dial type 0°—250°C, long lead mercury in steel
- (2) Thermometres, mercury in glass type, 0°—250°C
- (3) Straight edge (3 metre)
- (4) Unevenness indicator (Optional)
- (5) Camber board
- (6) Depth gauge

F. Tools and appliances for safety during construction

- (1) Road barriers
- (2) Diversion boards
- (3) Caution boards
- (4) Red flags
- (5) Red lamps
- (6) Field tent and accessories
- (7) Gumboots
- (8) Gloves
- (9) Goggles
- (10) Firstaid box

4. SPECIAL EQUIPMENT FOR SURFACE DRESSING

4.1. Manual Methods

Where surface dressing is done by manual methods the following equipment are needed:

- (1) Manually operated sprayers
- (2) Three-wheel steel roller, 6-8 tonnes, or alternatively smooth pneumatic tyred roller.

4.2. Mechanized methods

Where surface dressing is done by purely mechanized methods, the following equipment are needed:

- (1) Self-propelled bitumen pressure distributor
- (2) Gritter
- (3) Three-wheel steel roller, 6-8 tonnes, or alternatively, smooth pneumatic tyred roller.

5. SPECIAL EQUIPMENT FOR PREMIX-CARPET AND PREMIX SEAL COAT

For premix carpet seal coat works, the following special equipment are needed:

- (1) Manually operated sprayers (manual method)
or
Self-propelled bitumen pressure distributor (mechanised method), (for tack coat application)
- (2) Hand operated drum mixers (for small jobs)
or
Cold mixing plant (where cold mixing is permitted)
or
Mixing plant with arrangement for drying of aggregates
- (3) Steel-tyred three-wheel/tandem roller, 8-10 tonne or smooth pneumatic tyred roller.

6. SPECIAL EQUIPMENT FOR HOT-MIX CONSTRUCTIONS LIKE BITUMINOUS MACADAM, SEMI-DENSE CARPET AND ASPHALTIC CONCRETE

The following special equipment is needed for hot-mix constructions work:

- (1) Sprayer unit, such as a self-propelled bitumen pressure distributor or manually operated sprayer unit (for tack coat application)
- (2) Hot mix plant of adequate capacity with arrangement for heating/batching/mixing and storage
- (3) Tripper trucks for transport of mix
- (4) Paver finisher
- (5) Road rollers
 - (a) Three-wheel Steel roller—8-10 tonne capacity or pneumatic, smooth wheel roller 15-20 tonne for break-down rolling
 - (b) Tandem steel wheel roller, 8-10 tonne for final rolling.

7. SPECIAL EQUIPMENT FOR PENETRATION MACADAM AND BUILT-UP SPRAY GROUT

The following special equipment is needed for penetration

macadam and built up spray grout:

- (1) Sprayer unit, such as a self-propelled bitumen pressure distributor or manually operated sprayer unit
- (2) Three-wheel steel tyred roller, 8-10 tonne.

8. SPECIAL EQUIPMENT FOR MASTIC ASPHALT

The following special equipment is needed for mastic asphalt:

- (1) Mastic cooker of adequate capacity with arrangement for heating and mixing of aggregates with bitumen
- (2) Wooden floats of suitable design.

9. FIELD LABORATORY

Apart from the equipment, tools and appliances required for construction as mentioned above, it will be necessary to set up a well-equipped field laboratory for regularly carrying out quality control and acceptance tests. Equipment required for such a laboratory are listed in *Appendix*.

10. BRIEF DESCRIPTION OF TOOLS & EQUIPMENT AND THEIR SPECIFICATIONS

10.1. Cleaning tools

10.1.1. In all bituminous specifications, it will be necessary to clean the surface which is to receive the bituminous layers. The usual equipment needed for this operation are:

- (i) Brooms
- (ii) Wire brushes
- (iii) Coir brushes
- (iv) Gunny bags

The use of mechanical brooms is not yet widespread in this country and such brooms are not manufactured indigenously.

10.1.2. **Brooms:** Ordinary brooms made of coconut sticks/ any other locally available material found suitable for sweeping layer of dust, leaves etc.

10.1.3. **Wire brushes:** Wire brushes as shown in Fig. 1 will be found useful for cleaning water bound macadam and bituminous surface which are badly rutted and worn out. These brushes will also be effective in removing caked mud, cow dung and similar extraneous matter.

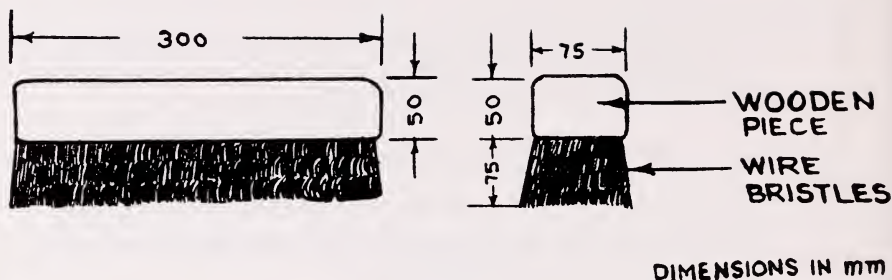


Fig. 1. Wire brush
Source—IS:898-1964

10.1.4. **Coir brushes:** Coir brushes as shown in Fig. 2 will be found useful for sweeping black-topped surfaces.

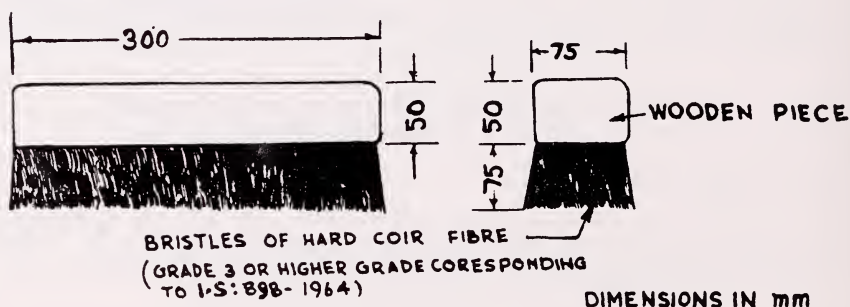


Fig. 2. Coir brush
Source-IS: 898—1964

The coir fibres should meet with the requirements of IS:898-1964 "Specifications for Coir Fibre" and be of Grade III or higher specification. The brushes should be replaced when the coir bristles wear down to a length of about 40 mm.

10.2. Bitumen Heating and Handling Equipment

10.2.1. **Equipment for bulk supply:** Bulk supply of bitumen has a number of advantages over supply in drums. These are:

- (i) Saving in the cost of steel sheeting for manufacture of drums;
- (ii) No wastage of bitumen on account of drums not being completely emptied at the time of filling the boiler; and
- (iii) Savings in the cost of heating the bitumen and handling of drums.

In view of the above inherent advantages of bulk supply of bitumen, it is envisaged that this supply method will become increasingly popular in the country.

10.2.2. Where the demand for bitumen is fairly large, it would be desirable to establish bitumen storage depots which would receive and store bulk bitumen and distribute it to individual customers. Suggested layouts for storage depots are given in Figs. 3 and 4. These layouts should be considered as illustrative and may need alterations depending upon the actual site conditions.

10.2.3. Bitumen tankers: Bulk bitumen lorries are intended to transport bulk bitumen either directly from the refineries or from the bulk storage depots to the points of actual consumption. The lorries are fitted with tanks of 5,000 to 15,000 litre capacity and are used to operate within economic distance from the refineries and the storage depots. They are equipped with arrangements to maintain temperature of bitumen during transit. Oil fired heaters are used for this purpose. Unloading of the lorries is usually carried out by compressed air or gear pumps. A sketch of the bulk bitumen lorry is given in Fig. 5.

10.2.4. Bitumen boilers: Bitumen boilers are available in 100-10,000 litre capacity range. These are portable and are generally fired by oil, coal or fire-wood. The Indian Standard IS: 2094-1974 "Specification for Heaters for Tar and Bitumen" lays down the requirements of such boilers. The following nominal capacities have been prescribed in the above standard:

100, 300, 500, 1000, 1500, 2000, 3000, 5000, 7500 and 10,000 litres.

10.2.5. Arrangement for lifting asphalt drums: Where bitumen is supplied through packed steel-drums, an arrangement for lifting the drums to the inlet of bitumen boilers becomes necessary. This normally consists of a chain-pulley system. The arrangement, if it is an adjunct to the boiler, should be so designed that the boiler is stable under all normal working conditions. A small oil fired bitumen boiler with the chain pulley arrangement for lifting drums is depicted in Fig. 6.

10.3. Bitumen Spraying Equipment

10.3.1. Bitumen pressure distributors: This is a mechanical equipment for spraying bitumen for surface dressing or grouting specifications, and is convenient to use in conjunction with bulk bitumen

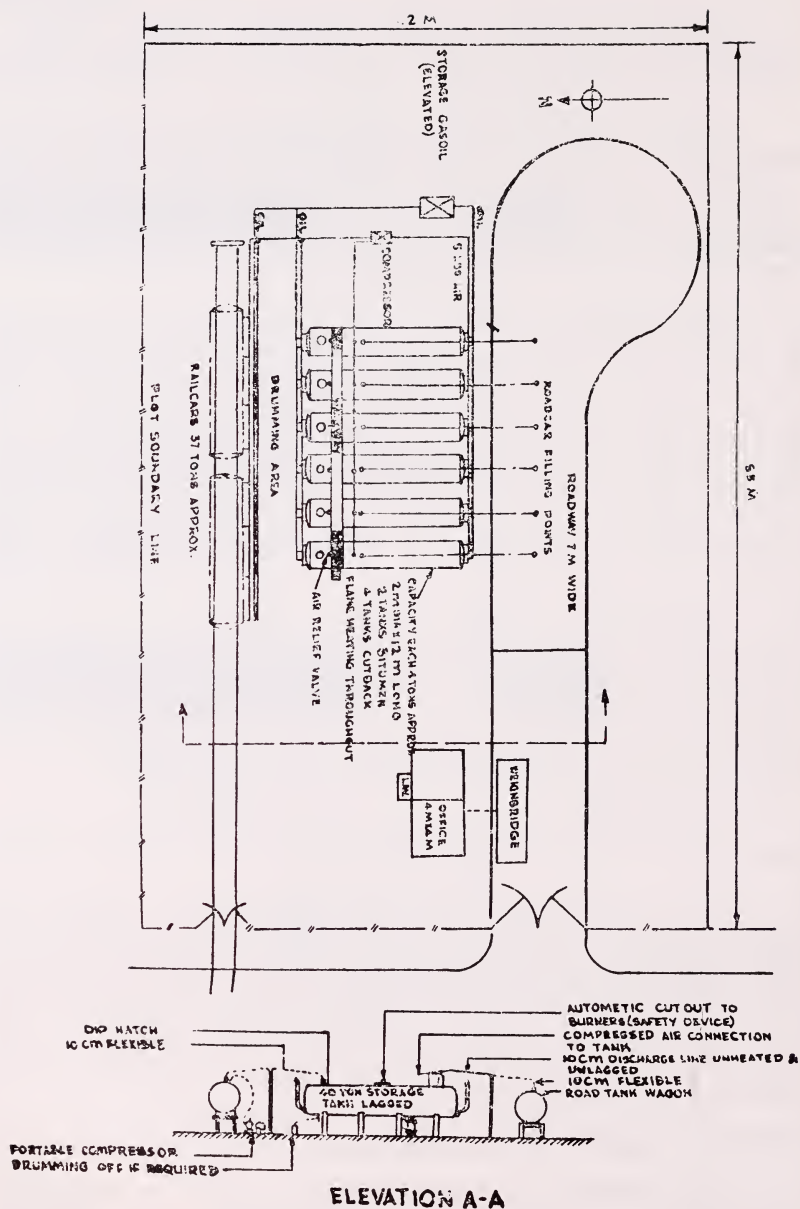


Fig. 3. Typical layout of bulk bitumen storing site (Example 1)
Source: M/s Bharat Petroleum Corporation Ltd.

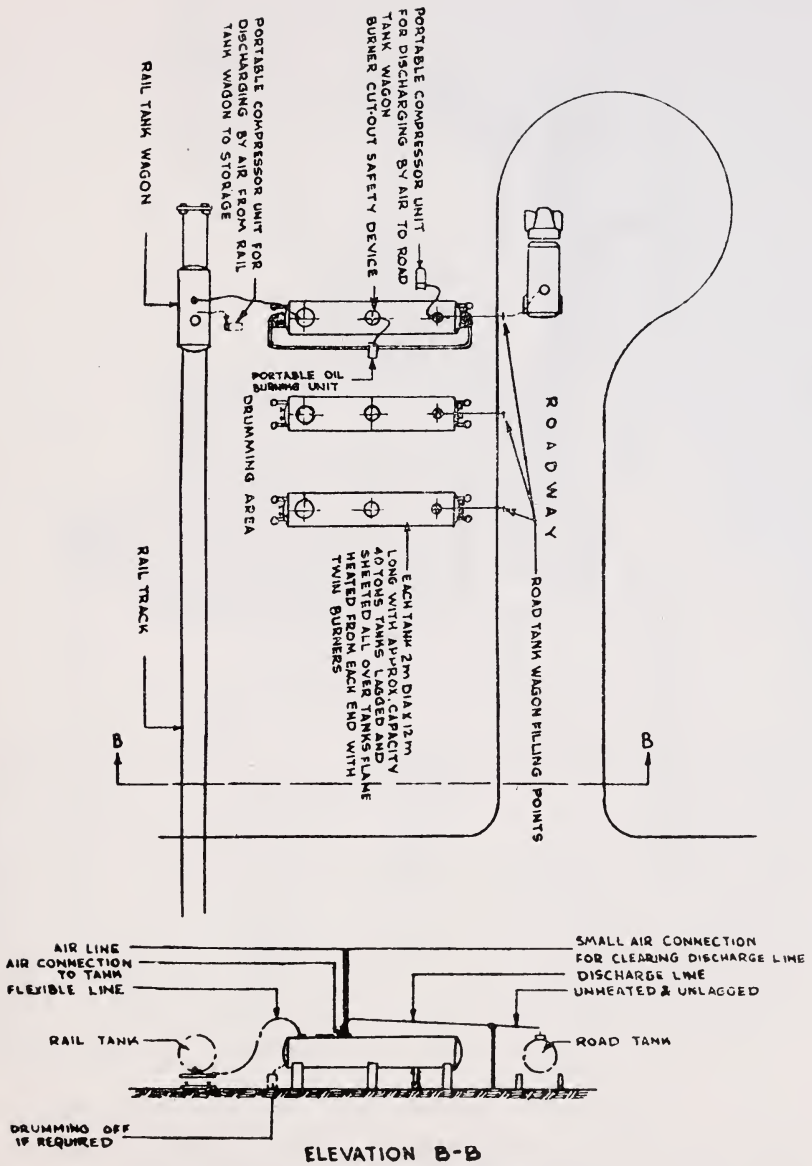


Fig. 4. Typical layout of bulk bitumen storing site (Example 2)
Source: M/s Bharat Petroleum Corporation Ltd.

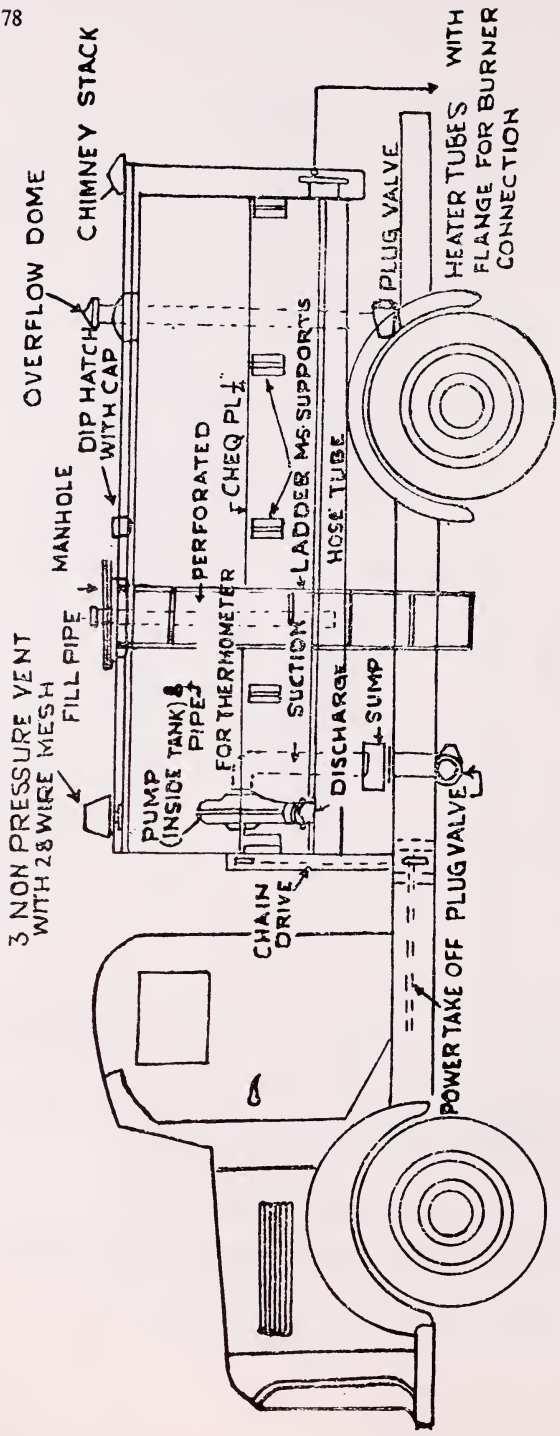


Fig. 5. Bulk bitumen Tanker

Source: M/s Hindustan Petroleum Corporation Ltd.

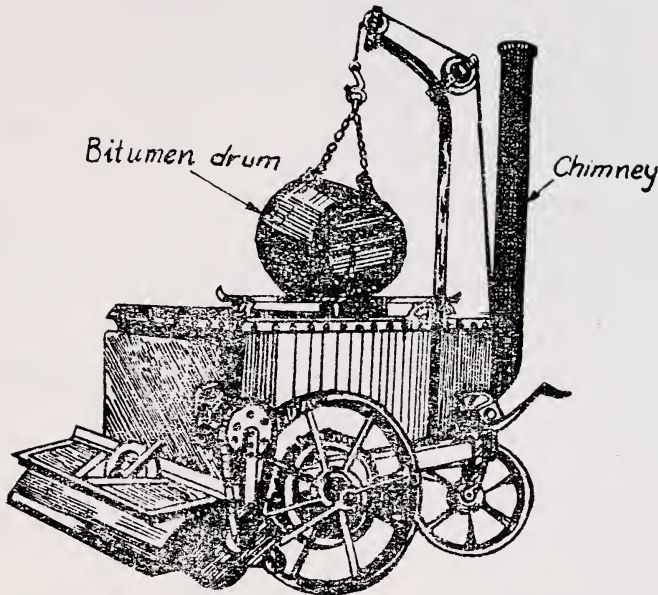


Fig. 6. An arrangement for lifting bitumen drums

supply. It consists of a pneumatic tyred lorry on which is mounted an insulated tank or a tank with a heating system, usually oil fired burners, with direct heating from the flues passing through the tank. A power driven pump or a compressed air pump designed to handle bitumen is usually fitted to the vehicle. A spraybar unit with nozzles is fitted at the rear of the tank through which bitumen is applied under pressure on to the road surface. The quantity of bitumen flow is controlled by a metering device. The speed at which the vehicle is operated controls the rate of spread of the bitumen. Indian Standard, IS:2093-1974 "Specification for Distributors for Hot Tar and Bitumen" deals with the requirements of this equipment. The following sizes are listed in the I.S.:

1000, 1500, 2000, 3000, 5000, 7500, & 10,000 litres.

10.3.2. Bitumen hand spraying equipment: For small works not warranting the induction of a bitumen pressure distributor, the usual method of spraying bitumen on the road surface is by small pumps attached to the bitumen boiler itself. These pumps may be either mechanically operated or hand-operated. The equipment assembly consists of the pump, a strainer attached

on the pump suction pipe, a flexible pipe, a spray lance, and a spray nozzle. The rate of application of the bitumen on the road surface can be varied according to the height of the nozzle above the ground. Uniformity of spraying is controlled by the angle at which the spray bar is kept. An angle of 45° ensures uniform spraying.

10.4. Mixing Equipment

10.4.1. Hand operated drum mixers: For small premix jobs and in situations where mixing plant is not available, hand operated drum mixers are usually employed. The drum mixers can either be of improvised type (using second-hand oil drums) or a specially manufactured unit.

Sketch of an improvised drum mixer is given in Fig. 7.

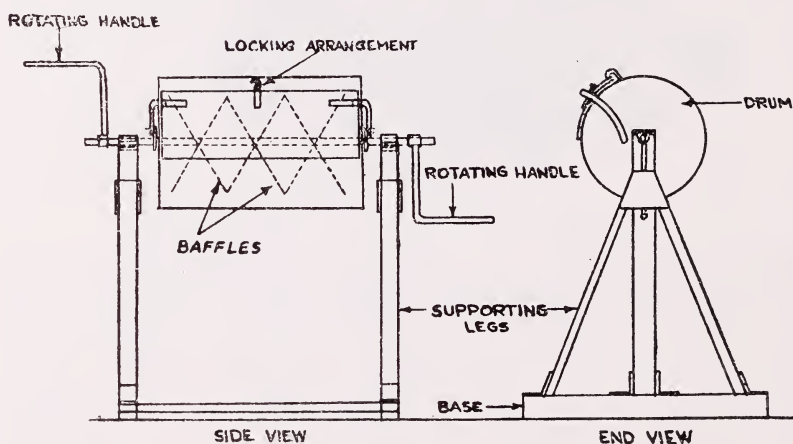


Fig. 7. Improved drums mixer

Source : Bharat Petroleum Corporation Ltd.

The improvised drum mixer consists of a second-hand oil drum with baffles provided inside to facilitate the mixing of bitumen and aggregates. The drum is operated by rotating handles at either end and is supported on wooden or angle iron stands.

Specially manufactured hand-operated drum mixers are covered by IS:2434-1973, "Specification for Hand-operated Drum Asphalt Mixers". A sketch of a typical coal-fired hand-operated drum asphalt mixer recommended in the above standard is given in Fig. 8.

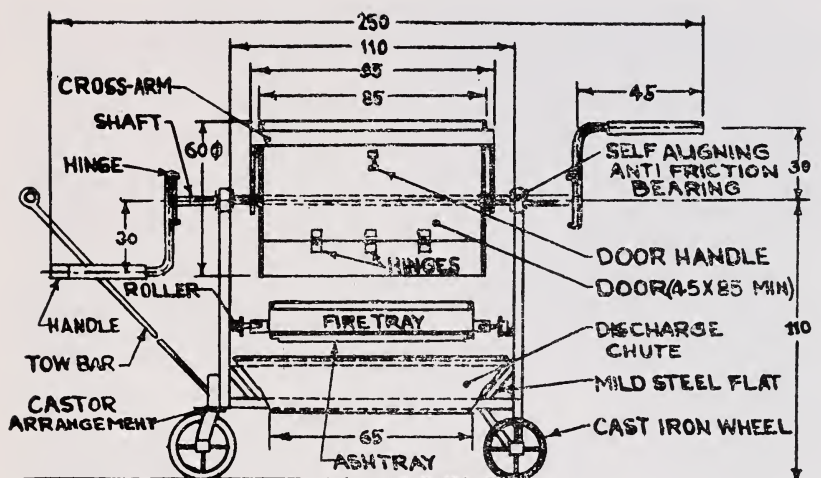


Fig. 8. Indian Standard hand drum mixer

Source : IS: 2434—1973

A sketch of a typical hand-operated combination type coal/oil fired, asphalt mixer also recommended in the Indian Standard is shown in Fig. 9.

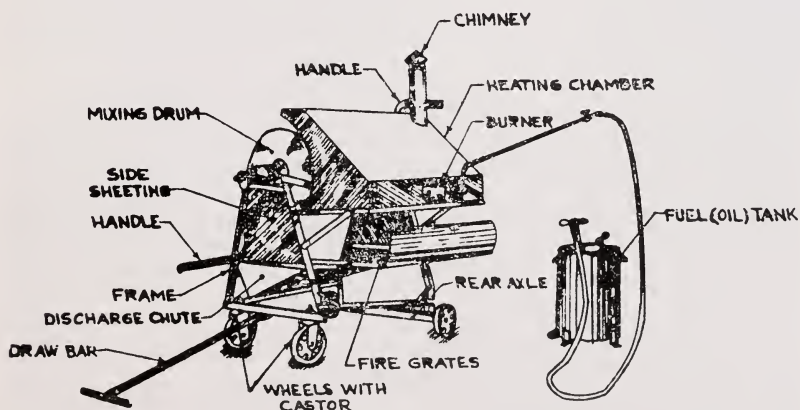


Fig. 9. Indian Standard hand operated combination type coal/oil fired asphalt mixer

Source : IS: 2434—1973

The drum mixers are sometimes made portable by providing wheels with castors and a draw bar for being pulled by a tractor or the suitable arrangement.

10.4.2. Cold mixing plants: Cold mixing plant is used where cold mixing is permitted by the specification. Indian Standard IS:5435-1969, "Specification for Cold Asphalt Macadam Mixing Plants" covers the requirements of such plants. The plant consists of an aggregate feeder, a mixing unit with elevator and bitumen heating and storage unit.

10.4.3. Small capacity hot-mix plants: Small capacity mixing plants which do not have elaborate system for heating the aggregates are used for premix work such as open graded carpets and bitumen macadam. Such plants have an arrangement for drying the aggregates either in a separate drier unit or in the mixing drum itself. The former type is covered by IS:5890-1970, "Specification for Mobile Hot Mix Asphalt Plant, Light Duty". This standard requires that a separate provision be made for a drier unit and in no case shall the mixing be carried out in the drier drum. The capacity of such plant as standardized by the IS is either 3-5 tonnes/hr. or 6-10 tonnes/hr.

Light duty plants where the mixing drum contains burners for drying the aggregates are also available in the country.

10.4.4. Large capacity hot-mix plants: Hot mix plants are required for major bituminous works such as bituminous macadam and asphaltic concrete. The Indian Standard IS:3066-1965 "Specifications for Hot Asphalt Mixing Plants" covers the requirements of such plants. The capacities of the plant as listed below are indicated in the above Indian Standard:

20-30 tonnes/hour
30-45 tonnes/hour
40-60 tonnes/hour
60-90 tonnes/hour
80-120 tonnes/hour

These plants can be either mobile or static. Further, these can be of the continuous type or batch type. The important components of the plant are :

- (i) Arrangement for cold feed
- (ii) Drier unit for heating the aggregates
- (iii) Screens and bins for separating and storing
- (iv) Bitumen heating and storage tank
- (v) Arrangement for accurately proportioning each constituent such as the aggregate, filler and bitumen
- (vi) A mechanical mixer

A typical arrangement of a batch-type hot mix plant is shown in Fig. 10.

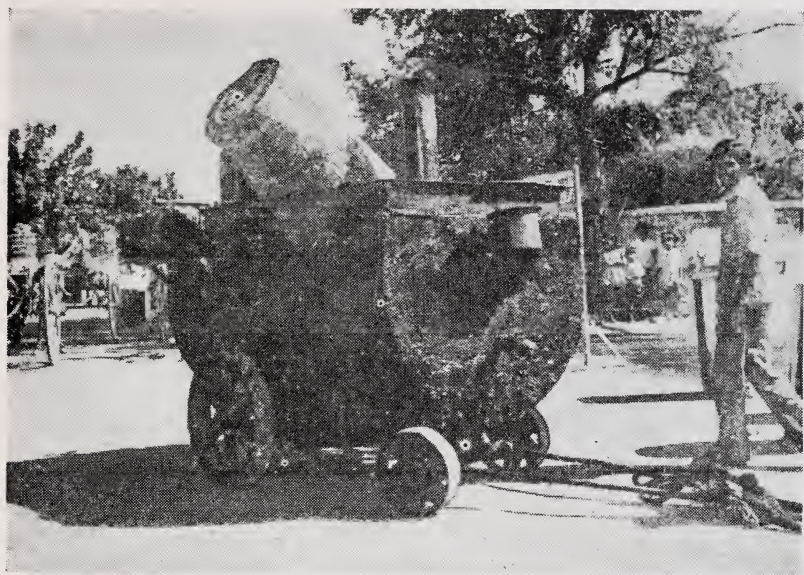


Photo 1. Bitumen Boiler



Photo 2. 3-Wheel Steel-tired roller



Photo 3. Cold mixing plant

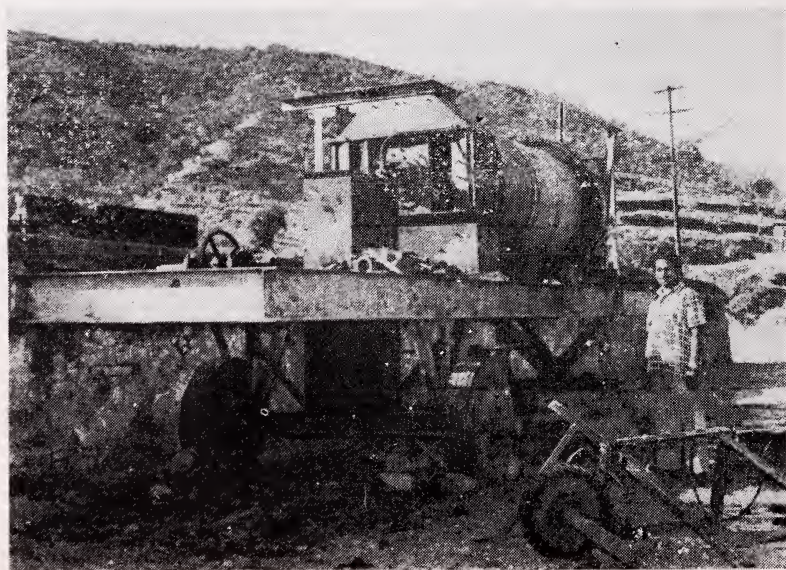


Photo 4. Mini-hot-mix plant



Photo 5. Hot-mix plant

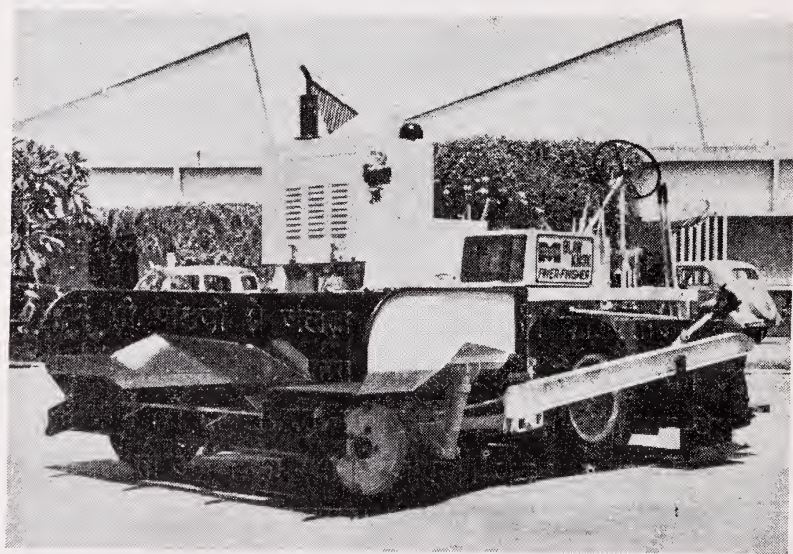


Photo 6. Paver Finisher

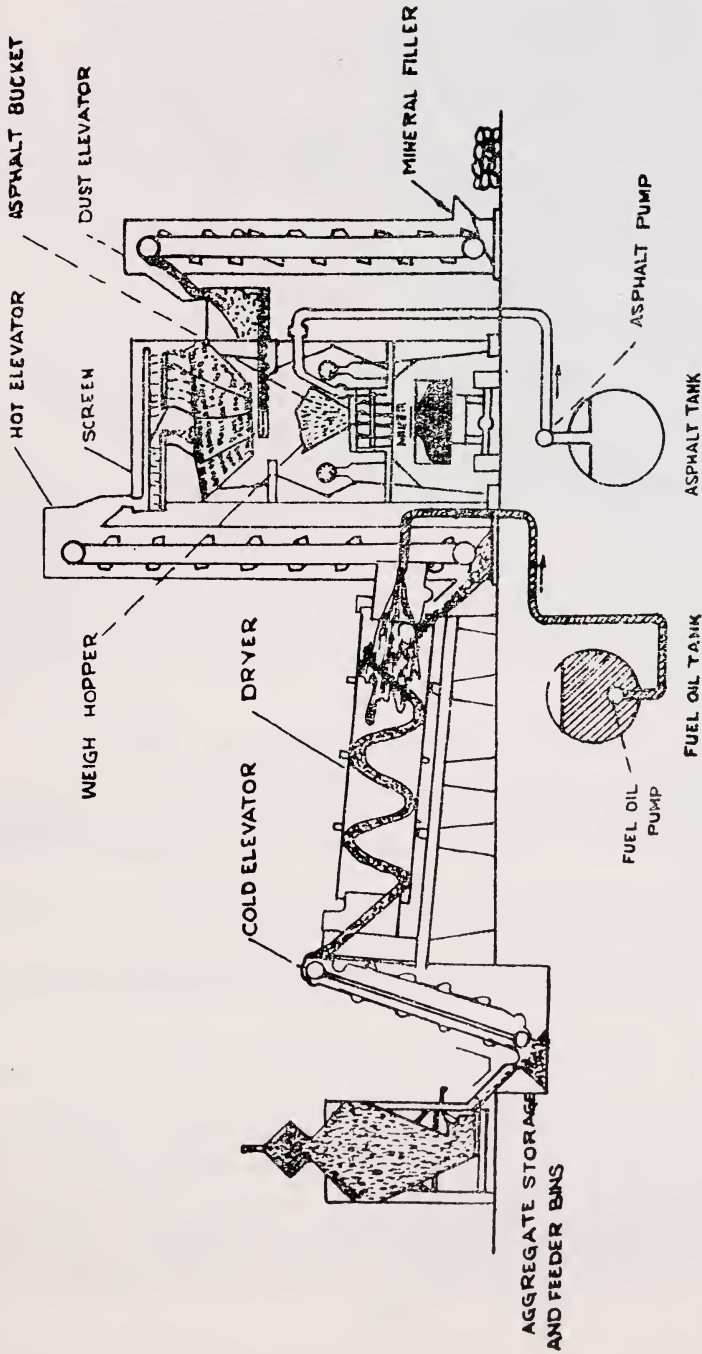


Fig. 10. Batch type hot-mix plant
Source: CRR I

10.5. Equipment for Transport of Bituminous Mix

10.5.1. Wheel barrows for small scale work: The premixed material is conveyed from the mixer to the place where it is to be laid by means of wheel barrows. Wheel barrows can either be of single wheel type or two wheel type. The former is covered by IS: 2431-1963 "Specification for Steel Wheel Barrows (Single Wheel type)" and the latter by IS:4184-1967 "Specification for Steel Wheel Barrows (with two Wheels)". They are normally available in the following nominal capacities:

Single-wheel wheel barrows	: 60 and 85 litre
Two-wheel wheel barrows	: 75, 85, 110 and 140 litre

10.5.2. Tipper trucks: For large scale bituminous work, especially in conjunction with hot mix plants, it is necessary to use tipper trucks for conveying bituminous mixtures from the asphalt plants to paver finishers. These tipper trucks can conveniently empty the bituminous mixtures into the hoppers of paver finishers directly. Trucks of 5-7.5 tonne capacity are generally used. The parts of the truck which come in contact with the bituminous mixture should be clean, smooth and free from cracks and holes so as to prevent the liquid bitumen from flowing out. The trucks should be provided with tarpaulins to prevent loss of heat from bituminous mixture during transit in winter. Double-walled trucks are also used for this purpose.

10.6. Equipment for Spreading Stone Chips (Gritters)

For large scale bituminous work involving the spreading of aggregates, it is convenient to use some form of mechanical spreader also known as gritter. There are two types of aggregate spreaders available :

- (i) Towed hopper type in which a large hopper with the spreading mechanism is towed by the bitumen distributor
- (ii) Tail board type aggregate spreader which spreads the aggregates as they are discharged from a lorry travelling in reverse. This is illustrated in Fig. 11.

10.7. Equipment for Spreading and Laying Bituminous Courses

10.7.1. For efficient spreading and laying of bituminous courses modern specifications require the use of paver finishers. A schematic diagram of a paver finisher is given in Fig. 12.

IS:3251-1965, "Specification for Asphalt Paver Finisher" covers the requirements for this item of equipment. The paver finisher has a hopper into which the bituminous mix is dumped. The

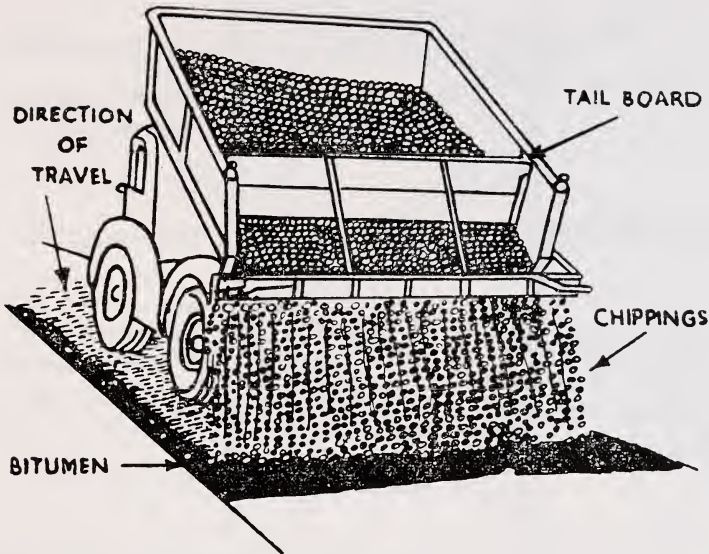


Fig. 11. Aggregate spreader

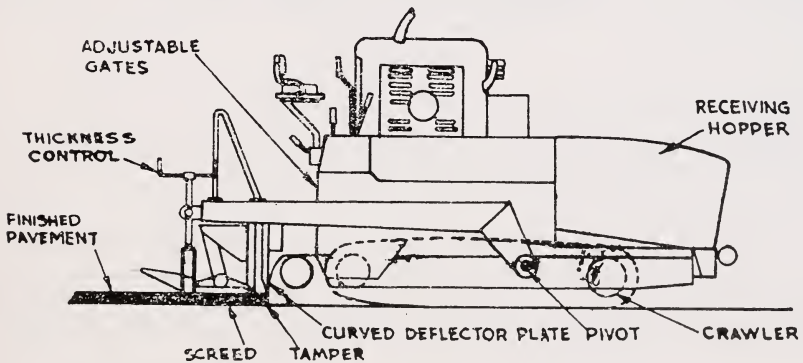


Fig. 12. Paver finisher

hopper has an adjustable opening at the bottom through which the mix can flow out on to the road surface as the paver moves forward. The equipment has a screed board attached to it which strikes off and imparts compaction to the mix. In order to prevent the mix from sticking to the screed plate, arrangement is also provided for heating the same at the start of the operations on a cold day.

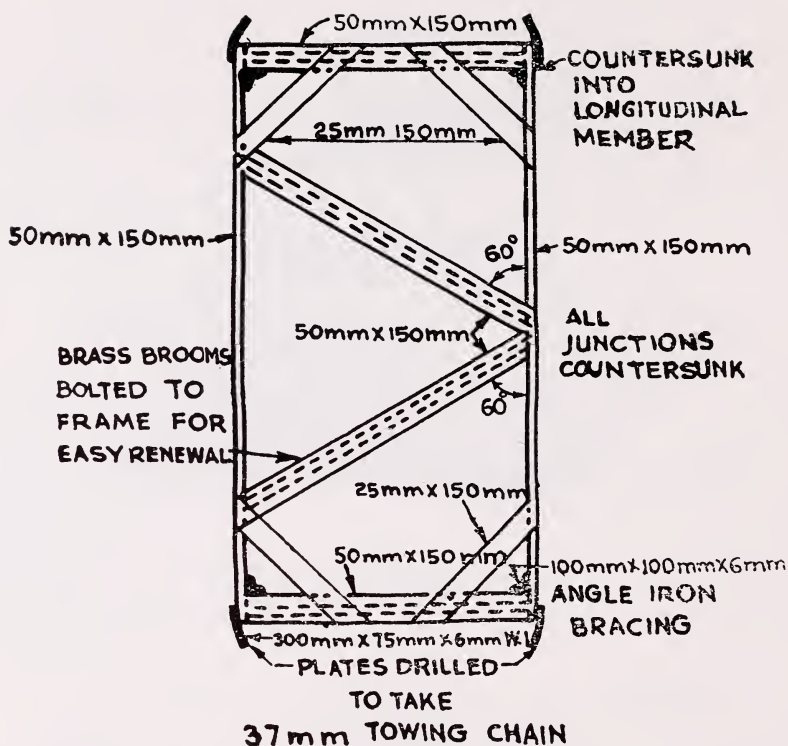


Fig. 13. Drag broom 3.75 m to 5 m long 1.8 m to 2.8 m wide frame of teak or pine position of brushes shown by ==

10.7.2. Equipment for manual spreading: When paver finishers are not available for laying the bituminous course, manual method of laying is resorted to. A drag spreader can be used with advantage for hand spreading. A sketch of suitable drag broom is given in Fig. 13.

Small tools such as camber board, templates, shovels, spades and rakes are also needed for hand spreading. IS:274-1966, "Specification for General purpose Shovels" and IS:1759-1961, "Specification for Powrahs" deal with shovels and powrahs may be referred to in this connection.

Fig. 14 gives a sketch for a rake with a long handle for spreading the bituminous mix manually.

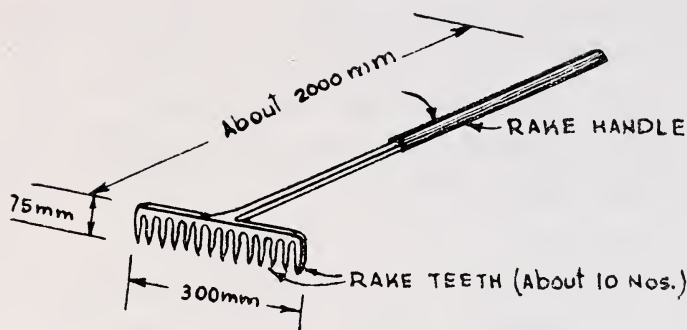


Fig. 14. Rake

In addition to the above, gumboots and gloves will be needed for the workmen handling bituminous mixtures.

10.8. Equipment for Mastic Asphalt

A mastic cooker is needed to prepare mastic asphalt. This cooks the aggregate and bitumen mixture to temperatures of 170 to 180 degrees centigrade. An arrangement for agitating the mix is provided inside the cooker. The period of cooking is generally about three hours for ensuring a thorough mix.

10.9. Rolling Equipment

10.9.1. Three-wheel roller: The standard equipment for break down rolling of asphaltic concrete, premix carpets and bituminous macadam is a three-wheeled steel roller 8/10 tonne and for rolling surface-dressing 6-8 tons. IS:5502-1969 "Standard Specifications for Smooth-Wheeled Diesel Road Rollers" covers the requirement of this item of equipment.

10.9.2. Tandem roller: Tandem rollers of 8/10 tonne capacity are needed for final finish rolling of asphaltic concrete and similar surfaces. IS:5502-1969 "Standard Specifications for Smooth-Wheeled Diesel Road Rollers" covers the requirement.

10.9.3. Pneumatic tyred rollers: These rollers consist of one or two axles on each of which is fitted a number of smooth pneumatic tyred wheels. Above the wheels is a flat bed or a hopper upon which weights are placed as ballast. The weight of the rollers can be varied by adjusting the ballast. The rollers may be either self propelled or towed by a tractor. They are used for intermediate

rolling of asphaltic concrete courses. A capacity of 15-20 tonne, with tyre pressure of 5-2-7.0 kg/cm² will be suitable.

10.10. Tools for Checking Surface Evenness

10.10.1. **Camber board/template:** Two designs for camber board/templates for checking the cross-profile of road surface are given in Figs. 15 & 16.

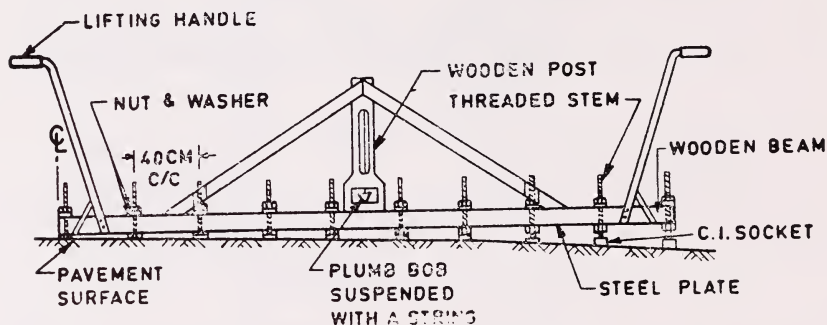


Fig. 15. One design of template with adjustable profile

Source: IRC : SP 11-1977

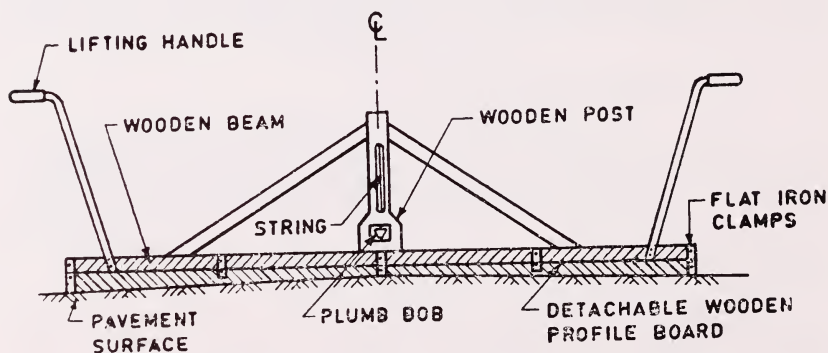
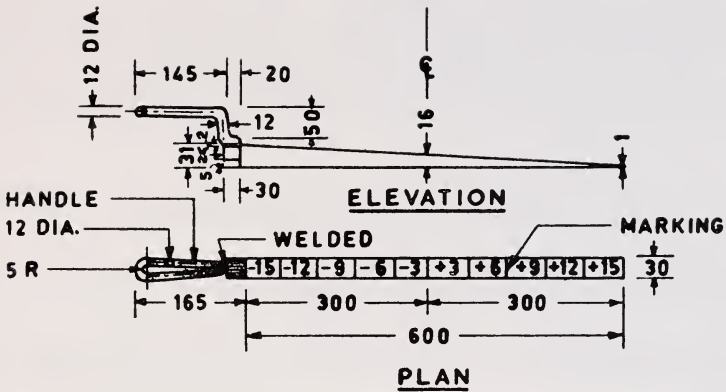


Fig. 16. Another design of template with adjustable profile

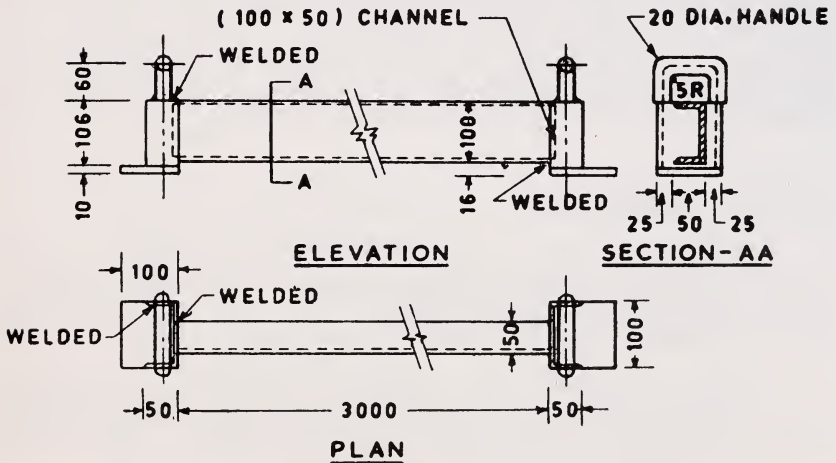
Source: IRC : SP 11-1977

10.10.2. **Straight edge:** For controlling the surface evenness of roads, a three-metre straight edge is needed. Fig. 17 gives suitable design for straight edge and graduated wedge.

10.10.3. For method of use of camber board and straight edge, reference may be made to Chapter 7 of IRC: SP 11-1977 "Handbook of Quality Control for Construction of Roads and Runways".



GRADUATED WEDGE (SEE NOTE 2)



STRAIGHT EDGE

(ALL DIMENSIONS ARE IN mm)

Fig. 17. Typical design plan straight edge of graduated wing and straight edge

Source: IRC : SP 11-1977

10.10.4. Unevenness Indicator: The unevenness Indicator, developed indigenously, is a travelling straight-edge type device, which, when pre-set according to the specification for the surface under check, performs the following functions on being run by two workmen along the lines of measurement at a walking speed of about 5 km per hour :

(i) Instantaneously indicates the size of irregularity through a pointer moving on a graduated dial, to an enlarged scale

(ii) Sounds a buzzer at locations where the irregularity is in excess of the maximum permissible (as pre-set)

(iii) Automatically marks, through colour spray, locations where the irregularity is in excess of the permissible maximum (as pre-set).

11. CARE IN OPERATION AND UPKEEP OF EQUIPMENT

11.1. The efficient operation of equipment and tools and their longevity depends to a large extent on observing set rules and procedures for handling and maintaining them. While suppliers of equipment normally indicate detailed procedures for the maintenance and operation of equipment, a few simple rules for the guidance of the field engineers are set forth below :

11.2. Bitumen Boilers

- (i) When the boiler is empty, it should be thoroughly cleaned of all foreign matter before it cools down and the thin bitumen sets and becomes hard. This procedure for cleaning should be followed every day.
- (ii) The portable boilers should be handled very carefully while being towed especially when loaded. They should not be towed by fast moving vehicles.
- (iii) The wheels and the pivoting carriage should be oiled daily.
- (iv) Before starting to heat the boiler in the morning, the inside should be inspected for the presence of any water which might have collected during the night. If water is present, the same should be dried before bitumen is poured in. The fire in the fire box should be lit only when there is at least some quantity of bitumen in the boiler.

- (v) Boiler should never be completely filled with bitumen. The bitumen level should be always at least 15 cm lower.
- (vi) The bitumen should be stirred from time to time with a long pole to ensure even distribution of heat.

11.3. Bitumen Hand Spraying Equipment

- (i) The strainers inside the bitumen boilers should be inspected to see that they are not blocked. If so, they should be cleaned with a blow-lamp and kerosene.
- (ii) The sprayer nozzle should be cleaned before and after each day's work.
- (iii) Pumping should be started only after the bitumen has reached the appropriate application temperature.
- (iv) The flexible hose connecting the heater with the nozzle should be inspected for any obstruction. The best way of clearing the obstruction is to blow hot air through the hose.
- (v) The spray lance should be checked for cleanliness and if it is blocked with bitumen, it should be cleaned with kerosene.
- (vi) As soon as pumping is stopped, the hose and the spraying parts should be hung up in a vertical position so that bitumen is drained out.
- (vii) Under no circumstances should the hose pipe be disconnected if there is any pressure registered on the pressure gauge as this may result in bitumen being splashed out and somebody being burnt.
- (viii) As soon as spraying commences, the fire should be made low. Otherwise there is danger of overheating the bitumen and also burning the plates of the heater.
- (ix) Once every month the whole pumping unit should be taken out and thoroughly cleaned with kerosene and the glands, gaskets and washers examined and replaced, if necessary.

11.4. Hand Operated Drum Mixers

- (i) The drum mixers should not be towed by fast moving vehicles.

- (ii) The wheels should be cleaned daily before and after use.
- (iii) The shaft bearing on which the drum rotates should be lubricated regularly.
- (iv) After each day's work, the mixer must be cleaned and the fire grate washed.
- (v) The bolts and nuts of the vanes inside the mixer should be checked periodically for tightness. The hinges of the door of the mixer should be examined and lubricated, if necessary.

11.5. Mixing Plants of Small Capacity

- (i) Adequate attention should be paid for lubricating the driving shafts, bearings, chains, hinged joints and all moving parts.
- (ii) Lubricating oils and grease should be replaced periodically.
- (iii) Linings inside the mixer should be examined and it should be ensured that they are not worn out.
- (iv) The mixer plates should be examined and it should be ensured that the bolts are in tight position.
- (v) The sliding door should be examined for case of operation and any sticking bitumen. It should be cleared periodically.
- (vi) The gear wheels provided for mobility of the equipment should be checked and lubricated periodically.
- (vii) The mixer box must be cleaned thoroughly after each working day.
- (viii) If a burner is provided inside the mixing drums, the same should be cleaned before and after each day's work. Nozzles should not be tampered with.
- (ix) The burner should always be kept free of dust.

11.6. Hot Mix Plant

- (i) The cold aggregate feeder controls must be set accurately and the setting should be checked before commencing each day's work.
- (ii) The burners provided in the drier unit should be kept free of dust.
- (iii) The sprayer nozzle holes of the burner unit should be cleaned before and after work. Nozzle should not be tampered with.
- (iv) The temperature indicating devices inside the drier unit should be checked for accuracy periodically.
- (v) The screens should be cleaned after each day's work and any worn out or broken screens replaced immediately.
- (vi) The overflow vents from the hot-bins should be checked to ensure that they are clear of obstructions.
- (vii) The pipelines connecting the hot bitumen heaters and the bitumen pumps should be cleaned of sticking bitumen periodically.
- (viii) The asphalt heating units should be inspected and cleaned of any foreign matter.
- (ix) Different parts of the mixer such as rotating blades and the lining should be periodically cleaned.
- (x) The weighing mechanism should be checked for accuracy periodically.
- (xi) The doors should be cleaned of all foreign matter and the hinges lubricated adequately.
- (xii) All driving shafts, bearings, driven chains, hinged joints, moving parts should be lubricated periodically.

11.7. Paver Finishers

- (i) The spreading screens in the hopper feeder should be checked for excessive wear and proper operation.

- (ii) On pneumatic tyred machines, the air pressure in the tyres should be checked and it should be ensured that this pressure is maintained.
- (iii) On crawler mounted machines, the crawler mechanism should be checked periodically.
- (iv) The flow control gate at the bottom of the hopper should be checked regularly for adjustment.
- (v) The heaters should not be used to heat the mix being delivered to the paver. These are intended essentially to heat the screed plate at the start of operations on a cool day.
- (vi) The screed plate should be checked periodically for excessive wear.
- (vii) At the end of the working day while the machine is still warm, hopper, feeders, spreading, screws, template boards and screed plate should all be cleaned with a petroleum distillate to ensure smooth start-up on next day.
- (viii) All the parts of the engine should be kept in proper working order. Lubricating oils should be replaced periodically. The water tank should be checked for its level.
- (ix) The oil filter should be cleaned periodically.

11.8. Rollers

- (i) The wear of the wheel rims should be checked. The surface of the steel tyres should be checked periodically for any depressions or grooves which are likely to impair the smooth surface.
- (ii) Bearings of the wheels should be checked for excessive wear and in case they are excessively worn out, they should be replaced before the rolling operations begin.
- (iii) Every day the engine oil level should be made up. The tension in the fan belt should be checked and corrected. All grease points should be lubricated.
- (iv) Once a week the fuel filter and the base of the air filter should be cleaned. Distilled water level in the battery

should be made up. All bolts, nuts and screws should be checked and the grease and oil points should be lubricated.

- (v) Once a month, the engine pump should be drained and re-filled. The lubricating oil filter should be cleaned periodically and new element fitted in.
 - (vi) The wheels of the roller should be free from caked mud and or other adhering matter.
 - (vii) The watering pipes over the wheels should be in working order and it should be ensured that there is enough water in the storage tank of the roller.
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RANGE OF EQUIPMENT REQUIRED FOR FIELD LABORATORY FOR BITUMINOUS WORKS

A. General items

1. Balances
 - (i) 7 kg to 10 kg capacity, self indicating type, accuracy 1 gm
 - (ii) Pan balance, 5 kg capacity
 - (iii) Chemical balance, 500 gm capacity, accuracy 0.0001 gm
2. Oven, Thermostatically controlled, upto 200°C
3. Riffle type sampler for coarse and fine aggregates
4. Sieves as per IS: 460-1962
 - (i) IS sieves—450 mm internal dia of sizes 100 mm, 80 mm, 63 mm, 50 mm, 40 mm, 25 mm, 20 mm, 12.5 mm, 10 mm, 6.3 mm, 4.75 mm, complete with lid and pan
 - (ii) IS sieves—200 mm internal dia (Brass frame) consisting of 2.36 mm, 1.18 mm, 600 microns, 300 microns, 212 microns, 150 microns and 75 microns with lid and pan.
5. Sieve shaker capable of taking 200 mm and 450 mm dia sieves.
6. Thermometers (glass).
 - (i) 0°—110°C range, six nos.
 - (ii) 0°—250°C range, six nos.
7. Thermometer, dial type
 - (i) 0°—250°C, two nos.
 - (ii) 0°—250°C, with sufficient lead for use in boiler, one no.
8. Kerosene/gas stove
9. Sand pouring cylinder with conical funnel and tap.

B. Items for testing aggregates

1. Aggregate impact testing machine
2. Flakiness index-test apparatus
3. Specific gravity bottle (for fine aggregate)
4. Cylindrical wire cage, 10 cm dia and 15 cm high, 6 mm mesh for specific gravity test on coarse aggregate
5. Standard cylindrical measures of 30, 15 and 3 litres capacity with standard tampering rod 60 cm length, 16 mm dia and bullet nosed for bulk density determination.

C. Items for testing bitumen and bitumen mixes

1. Penetration test apparatus
- **2. Centrifuge extractor for bitumen content test

- ***3. Constant temperature bath, thermostatically controlled
- ***4. Marshall test apparatus complete with moulds, compactor, loading/measuring units etc.

D. Miscellaneous items

1. Enamel trays of various sizes, caseroles (Porcelain) spatulas, tongs, tripods, hammer, clamps, rubber gloves, sample tins etc.
2. Kerosene oil, Commercial benylene, distilled water.
3. Grease, Cotton waste, paint, chalk etc.

** Required only for premix type constructions

*** These are for Marshall test, required only where the construction involves asphaltic concrete.

